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CONTENTS

THE PENNSYLVANIA CONNECTION: JASPER AT MASSACHUSETTS SITES Barbara E. Luedtke	37
SAVING A LATE ARCHAIC WORKSHOP FROM THE BACKHOE William E. Moody	48
ANALYSIS OF A COPPER ARTIFACT FROM THE PALMER SITE, WESTFIELD, MASSACHUSETTS James W. Bradley and S. Terry Childs	53
IN MEMORIAM: ROY C. ATHEARN, 1895-1986 Ruth Carol Barnes	58
IN MEMORIAM: ROLAND WELLS ROBBINS, 1908-1987 Elizabeth A. Little	59
INDEX TO VOLUMES 39 THROUGH 48, 1978-1987	60
THE CONTRIBUTORS	72

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THE PENNSYLVANIA CONNECTION: JASPER AT MASSACHUSETTS SITES.

Barbara E. Luedtke

Jasper, often referred to explicitly as "Pennsylvania jasper", is found in small quantities fairly often at Massachusetts sites, and is even sometimes considered diagnostic of the Middle Woodland period (Borstel 1984:244). Occasionally people have questioned whether this jasper is actually from Pennsylvania and whether it is associated always and exclusively with Middle Woodland assemblages. This paper will survey most of the known jasper sources in the Northeast and attempt to determine where the jasper found at Massachusetts sites came from and when it arrived at those sites.

SOURCES OF JASPER IN THE NORTHEAST.

Jasper, as used here, refers to a fine-grained, glossy variety of chert that can range in color from mustard (or golden, or honey) yellow to bright red to brown. A geological definition is, "A dense, opaque to slightly translucent cryptocrystalline quartz containing iron oxide impurities; characteristically red." (Parker 1984:376). Most cherts are composed of almost pure silicon dioxide, though they all also have varying amounts of "trace elements", or minor impurities present in proportions of a few parts per million (Luedtke 1978). However, the proportion of elemental iron in jaspers is usually significant, ranging from less than 0.1% to more than 5%. Often the iron is in the form of the mineral goethite, a yellowish iron oxide. When heated to about 400 degrees Celsius, goethite will turn to hematite and yellow jasper will turn red (Schindler, Hatch, Hay, and Bradt 1982). Such heat treating can be achieved in campfires, and will also make the jasper more lustrous and easy to flake.

Rhyolite "Jaspers".

Not all the materials called jasper in New England fit the above definitions. For example, Saugus "jasper", actually a rhyolite, was first described in 1886 by Henry Haynes, who recognized its igneous origin. "This is not a true jasper, but a compact, non-porphyrific petrosilex of a light red color. It occurs only in a small outcropping on the south side of the Saugus River, a short distance to the northeast of the railroad station at Saugus Centre" (Haynes 1985:42). Haynes reports that this outcrop was surrounded by chipping debris; more recently, it is said to have been destroyed by construction in the area. I suspect that this outcrop was an intrusive deposit into the Lynn Volcanics, to which Saugus rhyolite bears a strong chemical resemblance (Luedtke 1980b). There are persistent rumors that similar deposits may exist elsewhere in the Boston area, and this would not be surprising. The material is also available, usually in small fragments, in glacially deposited gravels on Boston harbor beaches. In terms of its visible characteristics, Saugus rhyolite can be confused with red jasper if the observer is not careful. It ranges in color from dark red (10R 3/3 on the Munsell color chart) to pink (10R 4/4), often with one to three millimeter thick veins of a cream or pale yellow color (10YR 8/4). It is never gold, and never has the veins of translucent chalcedony that are often found in true jaspers. Saugus rhyolite is fine grained but often shiny on the outside and dull on the inside, just the opposite of the weathering pattern for true jaspers. It also often bleaches to a pink color upon prolonged exposure to sunlight.

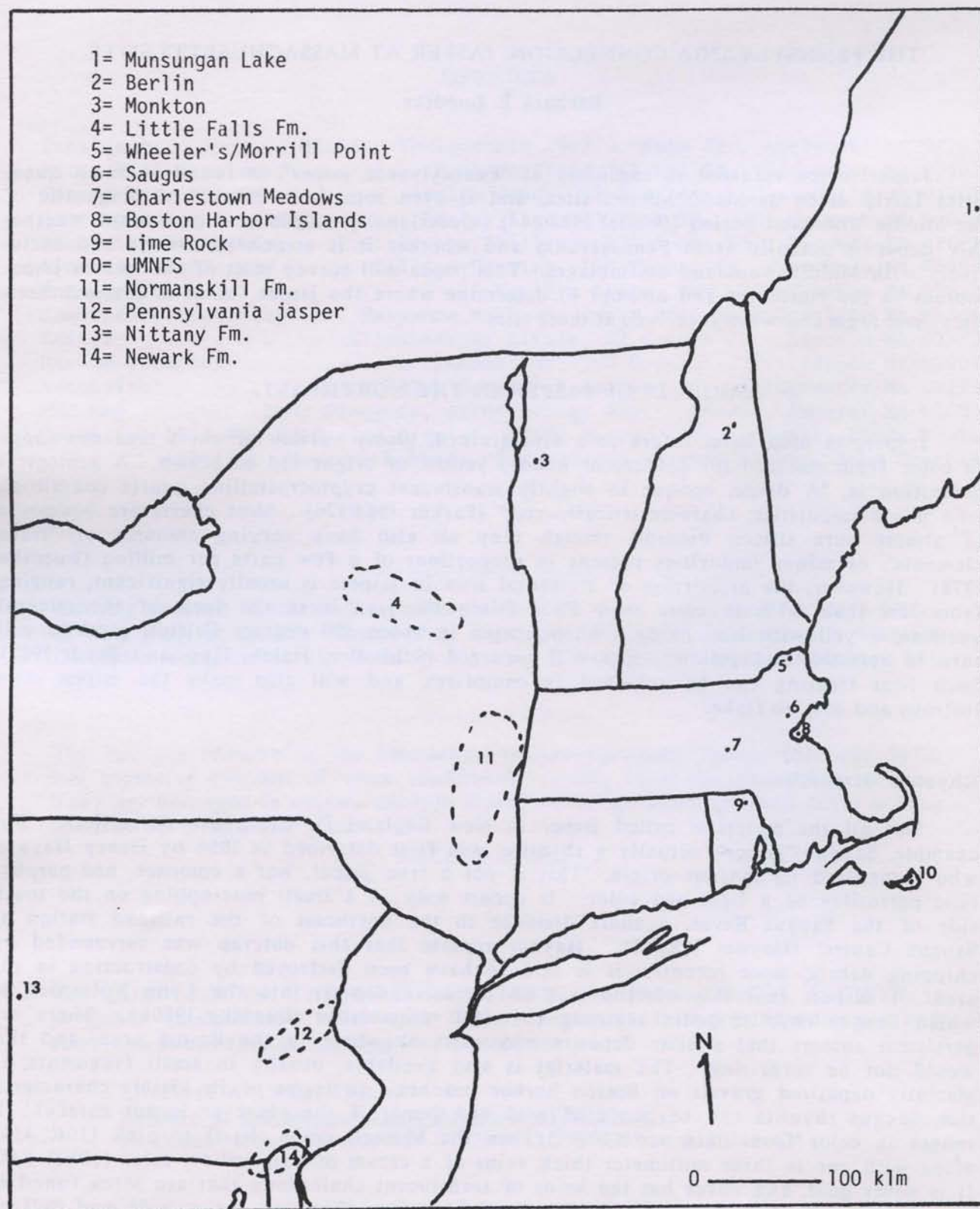


Figure 1. Sites and Lithic Sources Mentioned in Text.

Similarly, Berlin "jasper" from New Hampshire is an intrusive igneous rock, not a chert (Gramley and Cox 1976). This material is less easy to confuse with true jasper; when freshly broken it is greyish-green, though it weathers to a patchy brick-red. Flow banding is clear in both weathered and unweathered fragments.

Pennsylvania Jasper.

By far the most famous and extensive source of true jasper in the Northeast is the strip of outcrops in southeastern Pennsylvania extending some 60 kilometers from the Delaware River in Bucks County, through Lehigh and Berks Counties to the Schuylkill River (Figure 1). Ten major quarries are known, including the best known ones at Durham, Vera Cruz, Macungie, and Bowers Station, and numerous minor quarries can also be found. At most of these there is extensive evidence of open-pit mining. The ground surface is pocked with quarry pits ranging from 0.3 to three meters in depth and from seven to 20 m in diameter, often with edges overlapping (Hatch and Miller 1985). The quarries show evidence of use beginning in the PaleoIndian period and continuing on throughout the entire prehistoric sequence. Around the quarry pits there are numerous workshops with evidence of all stages of tool manufacture and of heat treating (Thomas nd). Although this is not the only source of jasper in the state of Pennsylvania, it is the variety commonly referred to by archaeologists as "Pennsylvania jasper".

The jasper itself has formed by replacement of sandstone and quartzite in the Hardyston Formation, which is of lower Cambrian age (Lavin 1983:140). The jasper can occur in beds up to three meters thick (Thomas nd), but most of the quarries are located where the jasper is available as cobbles in the soil (Hatch and Miller 1985). The material itself varies from a dark gold (10YR 4/6) to bright red (10R 3/3) to dark brown (2.5YR 2/4). When heat treated, the yellow varieties turn red. Pennsylvania jasper is usually opaque and quite shiny, though it may weather to a dull patina. It is sometimes mottled and often shows a distinctive "wood grain" effect. It also often has tiny veins of translucent chalcedony.

Lime Rock Jasper.

Chert of any kind is rare in southern New England, so there was considerable excitement among regional archaeologists when a true jasper source was discovered at the Conklin Quarry in Lime Rock, Rhode Island. This jasper is predominantly dark gold in color (10YR 6/6) ranging to dark brown (7.5YR 3/2). It is mostly opaque, but a translucent grey variety is also present. It has tiny veins of translucent chalcedony, much like Pennsylvania jasper, and bears a marked resemblance to that more famous material. It would undoubtedly turn red if heat treated.

Not long after its discovery, Dr. Maurice Robbins, who was then State Archaeologist of Massachusetts, asked Clifford A. Kaye of the United States Geological Survey to make a study of this quarry. Dr. Kaye reported the following observations in a letter to Dr. Robbins dated April 11, 1979:

"... fortunately, the origin of the Lime Rock chert is quite evident from its field relationships. I feel fairly sure that this is a collapsed sinkhole deposit formed during Tertiary or even Cretaceous time in the large lens of Precambrian marble that crops out here. We can see in the quarry side today the outline of the sinkhole and the rather spectacular mineralogy of the secondary deposits that formed in it. There are masses of pure goethite and manganese oxide dripstone. But more important, there are veins of clear, banded chalcedony as well as hard chert-like masses where

this secondary silica has impregnated the yellow ferruginous clay that is the principal material filling the sinkhole. These are the honey-colored chert boulders. This is, therefore, a secondary chert and is to be distinguished from primary cherts of marine origin which make up most artifact cherts.

I think it quite likely that all ferruginous cherts - particularly of this characteristic color - are of secondary sinkhole origin similar to that at Lime Rock and were formed in the rather special climatic and geochemical conditions that prevailed during the Tertiary in sinkhole environments. This means that in the late Tertiary, wherever slightly siliceous and highly calcareous limestones and marbles occurred, there were deposits of honey-colored chert; and because limestones and marbles of the required composition are fairly widespread, there were undoubtedly many such occurrences. While it is true that in eastern New England there are no wide-ranging limestones or marbles, lenticular marbles are known in several areas besides that of Lime Rock (see: B. K. Emerson, 1917, pp. 27-28, 42, 72, 83-84, as well as others I know about). In western New England, of course, there is a very prominent north-south marble belt. Glacial erosion during the Pleistocene removed most of the Tertiary sinkhole material but evidently remnants of larger and deeper sinkholes were left here and there, as at Lime Rock."

In my own visit to this quarry, I observed that the remaining part of the chert deposit appeared to be located well below the top of the quarry wall, suggesting that it might not have been exposed until modern quarrying uncovered it. The deposit may have originally extended to the surface, but it is also possible that this specific jasper source was not available to prehistoric people. However, as Kaye states above, other similar deposits are likely to have formed in similar geological circumstances, and some of them may have been exposed by erosion or glaciation. Jasper pebbles are occasionally found in glacial gravels along the north shore of Long Island Sound, and are also reported in conglomerates near Newport, Rhode Island (Kay and Chapple 1976). The new jasper source recently discovered in the western part of Massachusetts may also be an example of such a pocket of jasper that was made available to prehistoric people by erosion (Parrett 1985).

Other Sources.

There are still other sources of red chert in the Northeast, in the form of both bedrock deposits and of gravels or conglomerates derived from the bedrock. True jasper occurs in the Nittany dolomite of central Pennsylvania (Miller 1982), the Newark Formation of New Jersey (Lavin 1983:54-57), and the Monkton Chert of western Vermont (Lavin 1983:141). The Normanskill and Little Falls formations of eastern New York (Lavin 1983:70, 117) and the Munsungan formation of northern Maine (Pollock 1983) all produce red varieties of chert, though most of the chert from these formations is of other colors. In general, none of these red cherts are as fine quality as Pennsylvania or Lime Rock jasper, and most have coarser textures, duller lusters, and muddier colors. However, individual fragments of all these varieties of chert can be mistaken for each other.

THE SOURCE OF THE JASPER AT MASSACHUSETTS SITES.

Jaspers all tend to appear similar because they all get their coloring from iron. Therefore, simply looking at jasper artifacts can lead to incorrect identifications. A more reliable method of identification is to examine thin sections with a petrographic micro

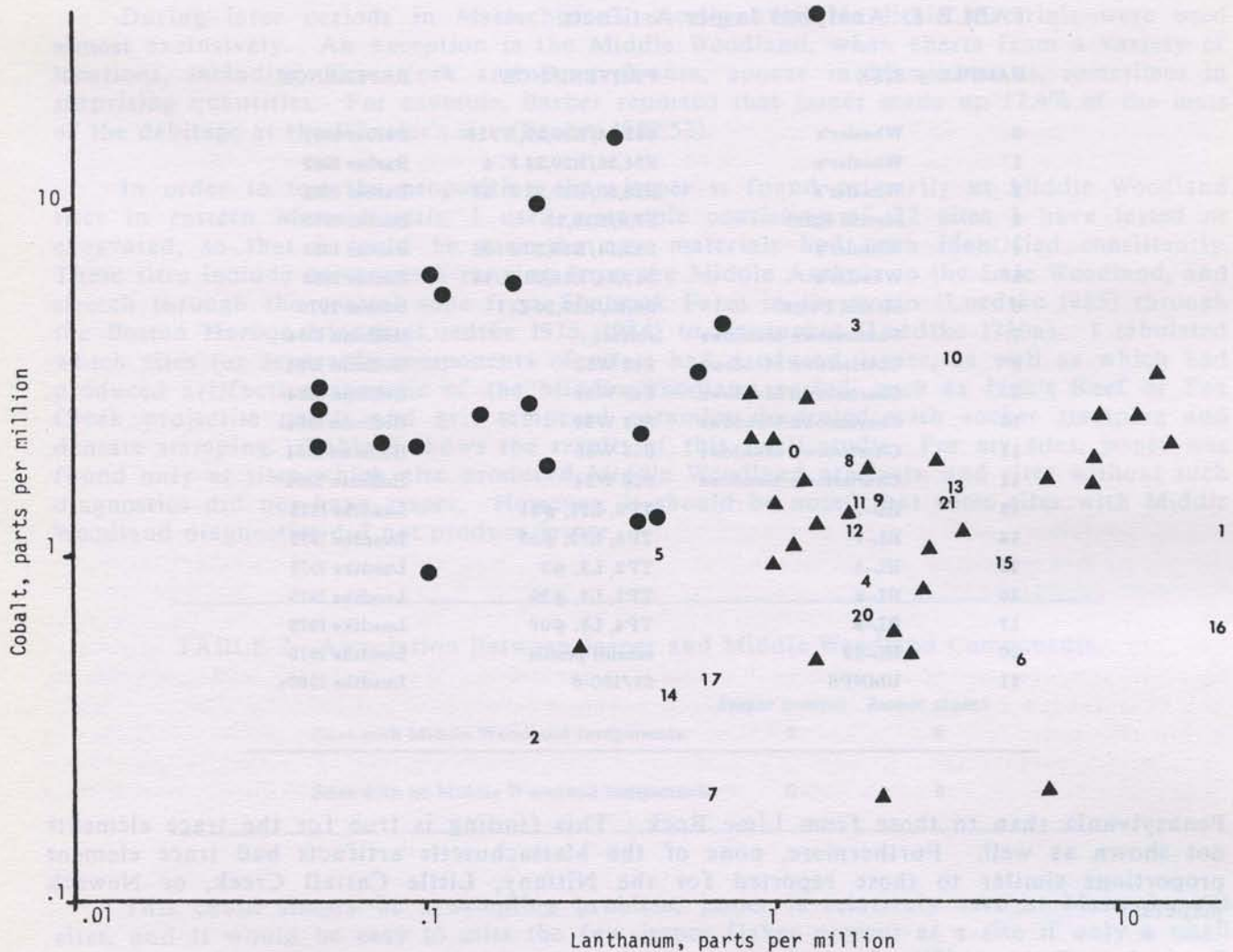


Figure 2. Trace Element Concentrations for Lime Rock Jasper (circles), Pennsylvania Jasper (triangles), and Artifacts (numbers).

scope, because many cherts have distinctive minerals and textures (Lavin 1983). Most cherts are also chemically distinct (Luedtke 1978), and one exploratory study of jasper in particular found clear differences between the Nittany, Hardyston ("Pennsylvania jasper") and Little Cattail Creek (Virginia) jaspers (Hatch and Miller 1985).

In order to determine more precisely the source of the jasper from Massachusetts sites, I used neutron activation analysis to obtain chemical data on 16 trace elements in samples of jasper from the Pennsylvania jasper and Lime Rock quarries, and also for jasper flakes from several eastern Massachusetts sites (Table 1 and Figure 1). The jaspers from Lime Rock and from Pennsylvania differ for many trace elements, but Figure 2 shows that there is good separation for proportions of the elements lanthanum and cobalt. It is also clear from this figure that the artifacts are more similar to the geological samples from

TABLE 1. Analyzed Jasper Artifacts.

SAMPLE #	SITE	PROVENIENCE	REFERENCE
0	Wheeler's	S12,14/E20,22, F. 18	Barber 1982
1	Wheeler's	S34,36/E20,22 F. 4	Barber 1982
2	Wheeler's	S28,30/E20,22 F. 28	Barber 1982
3	Morrill Point	S7,9/E19,20	Barber 1979
4	Wheeler's	S12,14/E18,20 F. 36	Barber 1982
5	Wheeler's	S12,14/E18,20 F. 16	Barber 1982
6	Morrill Point	S8,10/E19,20 L. 1	Barber 1979
7	Charlestown Meadows	surface	Hoffman 1984
8	Charlestown Meadows	S46 W33	Hoffman 1984
9	Charlestown Meadows	S49 W34	Hoffman 1984
10	Charlestown Meadows	S52 W34	Hoffman 1984
11	Charlestown Meadows	S55 W35	Hoffman 1984
12	Charlestown Meadows	S58 W34	Hoffman 1984
13	HL-7	TP3, L11, #31	Luedtke 1975
14	HL-7	TP3, L12, #33	Luedtke 1975
15	HL-8	TP2, L2, #3	Luedtke 1975
16	HL-8	TP1, L3, #29	Luedtke 1975
17	HL-8	TP4, L5, #97	Luedtke 1975
20	HL-22	seacliff profile	Luedtke 1975
21	UMNFS	61/180-6	Luedtke 1980a

Pennsylvania than to those from Lime Rock. This finding is true for the trace elements not shown as well. Furthermore, none of the Massachusetts artifacts had trace element proportions similar to those reported for the Nittany, Little Cattail Creek, or Newark jaspers.

A few of the artifacts are somewhat different from the Pennsylvania jasper samples, and could possibly have come from another jasper source. However, this is more likely to be a factor of the sampling. Most of the samples of Pennsylvania jasper I analysed came from the Vera Cruz quarry, and Hatch and Miller's data demonstrate that there is a certain amount of chemical variation between quarries of the Hardyston formation. Thus, some of these artifacts may simply have come from Pennsylvania jasper quarries other than the one at Vera Cruz.

These results do not mean that all jasper from Massachusetts sites will be found to have come from southeastern Pennsylvania. More thorough testing of artifacts and sources is of course necessary before such a statement could be proven. However, for reasons that will be discussed in the last section of this paper, I suspect we will find Pennsylvania was the primary source for the jasper that reached Massachusetts.

WHEN WAS JASPER BROUGHT TO MASSACHUSETTS?

Jasper has been found at many PaleoIndian sites in the Northeast, including Bull Brook (Byers 1954), Wapanucket (Robbins 1980:274, 282) and Reagan (Ritchie 1953). Only a few pieces of jasper were found at these sites, however, and other "exotic" cherts were more common.

During later periods in Massachusetts, locally available lithic materials were used almost exclusively. An exception is the Middle Woodland, when cherts from a variety of locations, including New York and Pennsylvania, appear in Massachusetts, sometimes in surprising quantities. For example, Barber reported that jasper made up 17.4% of the mass of the debitage at the Wheeler's site (Barber 1982:52).

In order to test the proposition that jasper is found primarily at Middle Woodland sites in eastern Massachusetts, I used a sample consisting of 22 sites I have tested or excavated, so that I could be sure the raw materials had been identified consistently. These sites include components ranging from the Middle Archaic to the Late Woodland, and stretch through the coastal zone from Shattuck Farm in the north (Luedtke 1985) through the Boston Harbor Islands (Luedtke 1975, 1984) to Nantucket (Luedtke 1980a). I tabulated which sites (or separable components of sites) had produced jasper, as well as which had produced artifacts diagnostic of the Middle Woodland period, such as Jack's Reef or Fox Creek projectile points and grit tempered ceramics decorated with rocker stamping and dentate stamping. Table 2 shows the results of this small study. For my sites, jasper was found only at sites which also produced Middle Woodland artifacts, and sites without such diagnostics did not have jasper. However, it should be noted that some sites with Middle Woodland diagnostics did not produce jasper.

TABLE 2. Association Between Jasper and Middle Woodland Components.

	Jasper present	Jasper absent
Sites with Middle Woodland components:	6	8
Sites with no Middle Woodland components:	0	8

This could simply be a sampling problem; jasper is relatively rare at Massachusetts sites, and it would be easy to miss the few jasper flakes present at a site if only a small proportion of it was excavated. However, at least two of my sites (Shattuck Farm Locus G and HL-11) produced large samples of flakes, yet absolutely no jasper (Luedtke 1985).

A second possibility is that jasper was not used throughout the entire Middle Woodland period. In the Northeast, the Middle Woodland is commonly divided on stylistic grounds into an early and a late phase; for example, in southern New England Snow defines a Fox Creek phase from A.D. 350 to 700, followed by a Fourmile Creek phase from A.D. 700 to 1000 (Snow 1980:281-282). Support for the idea that different patterns of stone tool material procurement may have existed during these periods comes from two shell middens on Long Island in Boston Harbor (Luedtke 1984). Both sites had considerable Middle Woodland components and many other similarities, but they produced quite different lithic assemblages. On the basis of differences in ceramic thickness and decoration (Luedtke 1986), I have suggested that one was used primarily during the earlier part of the Middle Woodland and the other during the later Middle Woodland. Jasper was found associated only with the later component. Furthermore, of all the Middle Woodland components in the sample of 22 sites described above that could be assigned primarily to the earlier or later portions of the Middle Woodland (on the basis of either radiocarbon dates or ceramic attributes), jasper was associated with only one of the six "earlier" components, but with five of the six "later" components.

Other Massachusetts sites support the suggestion that jasper is associated primarily

with the later Middle Woodland. The jasper-rich Wheeler's site produced radiocarbon dates ranging from A.D. 750 to 1250 (Barber 1982:14). The nearby Morrill Point site also produced jasper. Though considered by Barber to be predominantly of early Late Woodland age, it produced pottery that suggests to me that it was also used during the very end of the Middle Woodland period (Barber 1979:433). The Cunningham site on Martha's Vineyard also produced jasper artifacts in late Middle Woodland context (Ritchie 1969:122).

Further support for this hypothesis is provided by archaeological data from the Pennsylvania jasper quarry area itself. The Vera Cruz quarry was used during all pre-historic time periods, but was exploited intensively during the Middle Woodland (Hatch and Miller 1985:227). Lavin surveyed lithic materials at sites along the Delaware River drainage, just to the east of the Pennsylvania jasper quarries, and found that Pennsylvania jasper was rarely used during the Early Woodland but began to appear more frequently during the early Middle Woodland. It became a very important material at Delaware River Valley sites only during the late Middle Woodland, and then its use tapered off again during the Late Woodland. Specifically, Lavin says that Delaware watershed assemblages are mostly made of local raw materials during the early Middle Woodland Abbott Phase (associated in this region with Fox Creek projectile points), but mostly of jasper and other non-local cherts during the later Middle Woodland Point Peninsula Phase (associated in this region with Jack's Reef projectile points [Lavin 1983:247-248]).

REASONS FOR THE "PENNSYLVANIA CONNECTION".

Why was jasper brought more than 400 km from Pennsylvania to Massachusetts during the PaleoIndian and later Middle Woodland periods, despite the availability of many closer lithic sources? For the PaleoIndian period, the presence of small quantities of jasper is not at all surprising. Exotic lithic materials are characteristic of virtually all North American PaleoIndian assemblages. The PaleoIndians flourished in a difficult post-glacial environment, and their success was probably due in part to their organizational and technological flexibility, their seasonal movements over large territories, and to kinship and trade mechanisms which functioned to keep people in contact with one another. The presence of exotic lithic materials may simply be a reflection of these factors (Wilmsen and Roberts 1978:177-179). It is also possible that the PaleoIndians deliberately sought exotic lithic materials, perhaps to increase success in hunting. Snow points out that the dramatic color change that occurs when jasper is heat treated, and the similarity between the color of bright red jasper and of blood could have made jaspers especially attractive to hunting peoples (Snow 1980:132, 134).

The Middle Woodland period in eastern North America is also noted for the existence of large scale trade networks and long distance trade in lithic materials (Griffin 1983:265), but the motivations for this trade were surely very different than for the PaleoIndians. Exotic lithic materials are prominently associated with burial ceremonialism at Middle Woodland sites in the Midwest, and probably also served as status symbols in societies that were apparently beginning to evolve hereditary leadership and class differences (Griffin 1983:270). The great Hopewell trade networks had collapsed by A.D. 400, but some of the same social and ideological trends that stimulated interest in long-distance trade in the Midwest may have begun to influence southern New England at a somewhat later time.

Massachusetts has traditionally been seen as only marginally involved in Middle Woodland ceremonialism and trade, because of the lack of the more obvious manifestations such as moundbuilding, complex burial practices, and the manufacture of such artifacts as platform pipes, sculptures, and zoned rocker-stamped ceramic vessels (Snow 1980:285). However, the demonstrated trade in exotic cherts, and especially jasper from Pennsylvania, suggests that Middle Woodland people in Massachusetts were actively involved in relations

with neighboring groups. Jasper may simply be the tip of a "trade iceberg"; extensive trade networks focussed primarily on furs, shells, and other organic materials would leave few traces for archaeologists to find. The jasper itself may also have had ideological or aesthetic value simply because it is so very different from most local materials. At the Wheeler's site, Barber suggests that jasper artifacts were acquired as finished tools (judging from lack of evidence for on-site manufacture), and were highly valued (judging from the higher rate of resharpening, compared to tools made of other materials) (Barber 1982:103).

Many interesting research questions remain to be pursued. This study has focussed on eastern Massachusetts, and primarily on the coastal zone. Is jasper also found at inland sites and sites further north during the late Middle Woodland? Does its distribution follow the coastline, rivers, or both? Are there any indications of what materials might have been traded south in return for jasper? Did jasper function as a status symbol in Massachusetts? Was access to jasper restricted to certain individuals or families within the larger society? The "Pennsylvania Connection" was a unique phenomenon in Massachusetts prehistory, and it provides a fascinating opportunity for research on Middle Woodland trade and social relations.

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SAVING A LATE ARCHAIC WORKSHOP FROM THE BACKHOE.

William E. Moody

Throughout Massachusetts, construction of new commercial and residential structures continues to expand. Especially near natural watercourses and wetlands, such activity occasionally disturbs a previously unknown or unexcavated site of archaeological interest. Even when a briefly exposed site is not of major significance, it often affords a good opportunity to recover information and artifacts that can contribute to the overall knowledge of prehistoric inhabitants in a given area. Searching out these sites, properly retrieving any available artifacts, and accurately recording pertinent information can be an especially rewarding endeavor for the avocational archaeologist. This report presents the record of one such site.

THE SITE.

In the town of Pembroke, on the south side of the North River where the river is intersected by Highway 53, is a bluff that stands approximately five meters above the river (Figure 1). From the river the land rises very sharply and then levels off for a distance of some 45 meters in a southerly direction before the land again begins to take on an upward slope.

Both sides of the highway through this area in Pembroke are heavily built up with commercial structures. Until early 1986, the last remaining piece of undeveloped land was the small bluff site in the southeast quadrant where the highway crosses the river. It is here that the Late Archaic workshop was discovered after a construction crew had completed the initial phases of foundation excavation for a new commercial structure. An office building, "Barstow's Landing," and parking lot cover the site today.

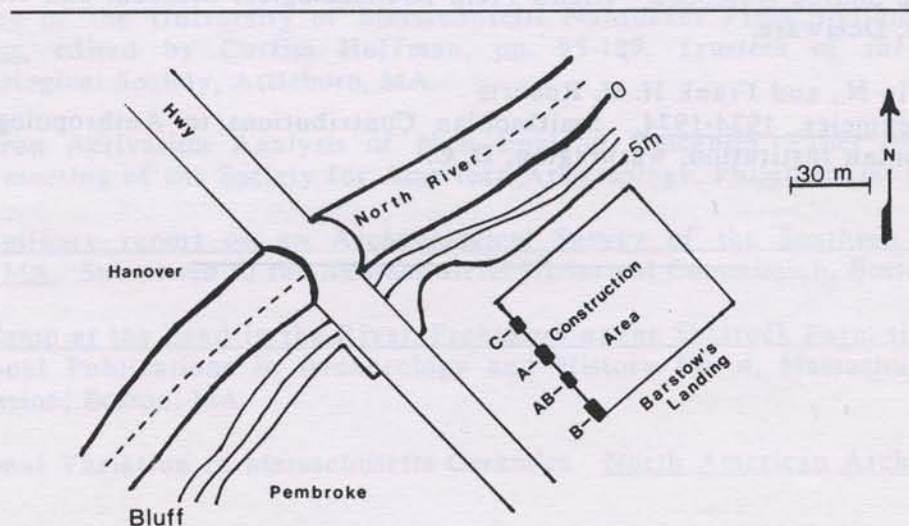


Figure 1. Sketch map showing relation of the construction area to the highway and North River, and locations of stations A, B, AB and C of the site. Any remains of the site are under pavement today.

The site was discovered on a January weekend in 1986 during an unusual three-day thaw where temperatures approached 50° F. On a Saturday afternoon drive I noticed several large piles of loam and subsoil sitting on the bluff next to the highway. Not having seen this excavation earlier and always on the lookout for construction activity along the river, I stopped to investigate. After searching the surface of the excavated dirt for about an hour I was disappointed not to have found any archaeological evidence or any identifiable lithic materials that might have been worked by prehistoric inhabitants.

I was preparing to leave the site when I decided to take a few more minutes and investigate the foundation walls that were formed by the excavation. These walls were cut approximately 2 1/2 meters deep into the earth (Figure 2). The first thing I noticed was a clearly defined soil stratigraphy, the lowest level being glacial pebbles and cobbles, above that an area of yellowish sand intermixed with pebbles, then light brown sandy subsoil, a tightly packed layer of dark humus, and finally a layer of sandy overburden of variable depth that was probably left during the construction of the highway many years earlier.

After another thirty minutes I was again disappointed not to have discovered any archaeological evidence for prehistoric human activity. As I was about to climb out of the foundation area, however, out of the corner of my eye I noticed a flake of a dark volcanic material protruding out of the foundation wall a few centimeters below the interface between the humus layer and the light brown subsoil, in Unit 4. Since I could see that the flake was man-made (it had flake scars on one surface, a striking platform, and a bulb of percussion on the opposite surface), I scraped back several centimeters of dirt at this point and saw that the soil was literally full of quartz debitage. With the permission of the building's architect, I was able to return on several weekends between January and March before the concrete foundation for the building was finally poured. It was a fairly

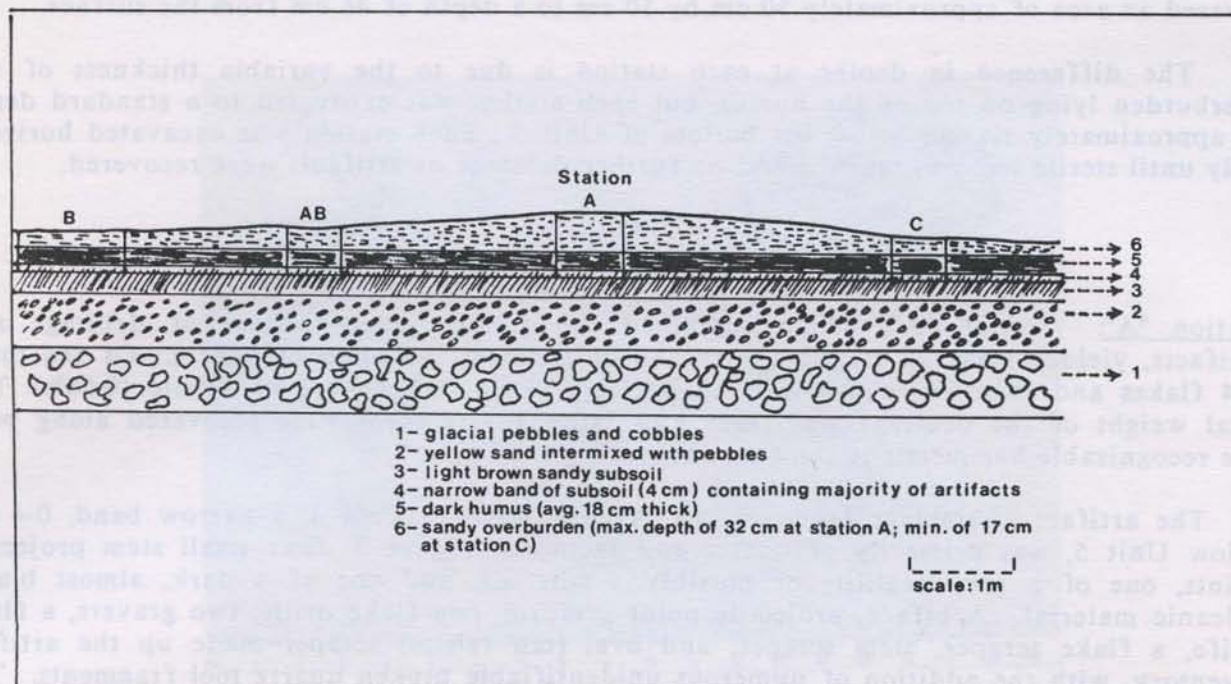


Figure 2. Profile of excavated foundation wall, showing soil stratigraphy and locations of stations where artifacts were recovered. Vertical scale equals horizontal scale, and the top of station A is 5 m above the river.

mild winter and the ground thawed enough on different occasions to allow archaeological work to progress sporadically.

Along the foundation wall, four separate locations containing artifacts were eventually discovered. But none was as densely filled with debitage or contained as many identifiable artifacts as the area where the first flake was found. The four locations have been termed stations "A", "B", "C", and "AB", in the sequence of their discovery (Fig. 2). Station "A" was located in the east-facing wall of the foundation (at the front of the construction site) at approximately 31 meters in a northeasterly direction from the highway shoulder and 40 meters in a southeasterly direction from the edge of the river.

METHODS OF EXCAVATING AND RECORDING.

Since a long profile of the soil was already exposed, the soil was scraped vertically in two centimeter increments from the foundation wall using a trowel. When an artifact was revealed, its distance from the surface was measured and recorded. The artifact was then carefully removed and given a catalogue number. If the ground was frozen, it was sometimes necessary to use a bristly brush to remove the soil in increments of only a few millimeters at a time.

The excavation at station "A" covered an area of approximately 65 cm by 65 cm horizontally, to a depth of approximately 56 cm from the surface. The deepest artifact recovered was at approximately 54 cm at the bottom of Unit 4. Station "B", located four meters southeast of station "A", covered an area of one meter by 50 cm, to a depth of 42 cm from the surface. Station "C" was located two and a half meters northwest of station "A" and covered an area of 50 cm by 50 cm to a depth of 41 cm from the surface. And finally, station "AB" was located two meters southeast of station "A" and, like station "C", covered an area of approximately 50 cm by 50 cm to a depth of 46 cm from the surface.

The difference in depths at each station is due to the variable thickness of the overburden lying on top of the humus, but each station was excavated to a standard depth of approximately six cm below the bottom of Unit 5. Each station was excavated horizontally until sterile soil was reached and no further debitage or artifacts were recovered.

RECOVERIES.

Station "A": Station "A", which contained the greatest concentration of debitage and artifacts, yielded some 457 waste flakes and chips, most composed of quartz. Of the total, 454 flakes and chips were quartz (99.34%); only three flakes were of felsite (0.66%). The total weight of the debitage was three kg. Nine quartz cores were recovered along with one recognizable hammerstone showing obvious signs of use.

The artifact assemblage from station "A", all found in Unit 4, a narrow band, 0-4 cm below Unit 5, was primarily of quartz and included (Figure 3) four small stem projectile points, one of a grey argillite or possibly a siltstone, and one of a dark, almost black, volcanic material. A biface, projectile point preform, two flake drills, two graters, a flake knife, a flake scraper, stem scraper, and oval (tan felsite) scraper made up the artifact inventory, with the addition of numerous unidentifiable broken quartz tool fragments. The only artifact not found in Unit 4 was the large triangular point of red porphyritic felsite with a snapped tip (Fig. 3, row 3: 2), recovered about 15 cm above the base of Unit 5.

Station "B": Station "B" contained the second highest concentration of debitage and artifacts. This larger area yielded some 221 waste flakes and chips. Of this total, 219



Figure 3. Artifact assemblage from station "A". Top row, left to right: 1) quartz small stem point (broken tip); 2) quartz small stem point (broken); grey argillite small stem point; 3) small stem point of dark volcanic material; 4) quartz biface; 5) quartz preform; 6) two quartz flake drills. Middle row: 1) quartz graver; 2) quartz graver; 3) quartz flake knife; 4) quartz flake scraper; 5) quartz stem scraper. Bottom row: 1) tan felsite oval scraper (chopper); 2) large triangular point (Levanna) of red porphyritic felsite.



Figure 4. Artifact assemblage from stations "B", "AB", and "C". Top row, left to right, station "B": 1) small quartz triangular point #4 (Squibnocket), with a broken tip; 2) small quartz triangular point #5 (Beekman); 3) quartz graver; 4) blue-grey felsite chopper. Bottom row: 1) station "AB", tan felsite small stemmed point; 2) station "C", felsite side-notched point #5 (Brewerton) with a broken tip; 3) station "C", a quartz scraper.

quartz (99.1%), and two were felsite (0.9%). The total weight of the debitage was 914 gm. Artifacts here were also recovered within a narrow band of four centimeters below the base of Unit 5. Identifiable artifacts included (Figure 4: top row) two triangular points of Late Archaic styles, a graver and a chopper. In addition, several broken tool fragments were in evidence.

Station "AB": Station "AB" contained about one dozen quartz chips. There was also (Figure 4, bottom row: 1) a small stem point of a tan felsite, which was recovered at four centimeters below the base of Unit 5.

Station "C": Station "C" yielded some 22 quartz flakes and chips. Also included (Figure 4, bottom row: 2 and 3) were a side-notched point #5 and a scraper. The depth below Unit 5 of both artifacts could not be accurately determined when they were recovered because a rain storm had washed a section of soil away from the exposed foundation wall.

CONCLUSIONS.

While the evidence obtained from this site is necessarily limited and sketchy, it does provide an opportunity to draw some reasonable conclusions. Because of the presence of a large number of waste flakes and other debitage such as broken tools, we can conclude that tool making and tool repairs as well as tool utilization were taking place at this site, which saw fairly heavy use as a workshop. The large amount of quartz being employed indicates that local cobbles left by glacial action were extensively utilized. The styles of projectile points and tools would suggest a Late Archaic association.

The one large triangular (Levanna) point recovered in a position clearly above the other artifacts illustrates a good stratigraphic sequence, as this type of triangular point is normally associated with the later Woodland Period. So, people of at least two different cultures employed this advantageous site along the North River.

One point of interest is that this particular site is not a south-facing site as is so common in New England, but faces in a northwesterly direction. However, because the site is situated on high ground with good drainage, adjacent to the river, with an excellent view in both upstream and downstream directions, we can conclude that these factors were more important for this site's occupants than orientation in a southeasterly direction.

Finally, the amount of material recovered even in the very midst of the site's destruction proves the value of being alert to new commercial and residential construction projects. Every bit of archaeological evidence saved from the backhoe can be a contribution to the knowledge of prehistoric activities in New England.

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ANALYSIS OF A COPPER ARTIFACT FROM THE PALMER SITE, WESTFIELD, MASSACHUSETTS.

by James W. Bradley and S. Terry Childs

The Palmer site (19-HD-97) is located in Westfield, Massachusetts, and is situated on a kame terrace overlooking a tributary branch of the Westfield River. In August 1975, workmen installing a utility trench for a new subdivision uncovered several human burials. With the permission of the developer, these burials were salvaged by members of the Westfield Historical Commission and graduate students from the University of Massachusetts at Amherst. In all, eleven graves containing the remains of at least fourteen individuals were uncovered (Moir, personal communication January 4, 1981; Cross, n.d.).

Given construction disturbance and salvage conditions, precise information is not available for all of the burials. Nonetheless, the majority appear to have been loosely flexed, single interments. Two multiple burials and one possible bundle burial were also noted. This pattern is consistent with Late Woodland mortuary practices elsewhere in southern New England.

Another Late Woodland trait was also observed, the lack of mortuary offerings. Only one of these burials, #103, had any artifactual accompaniment. This burial appeared to be that of a young female, aged between 10 and 14 based on dentition. The body was flexed, lying on the right side, and oriented with the head to the south and face to the east. Beneath the central portion of the vertebral column and resting on the bottom of the burial pit was a piece of copper. Though badly fragmented, this metal artifact appears to have been a single piece of sheet copper. The piece is quite irregular in shape and shows evidence of having been extensively deformed and, in places, cut (see Figure 1). The maximum dimensions are 66 mm by 36 mm; it is approximately one mm thick.

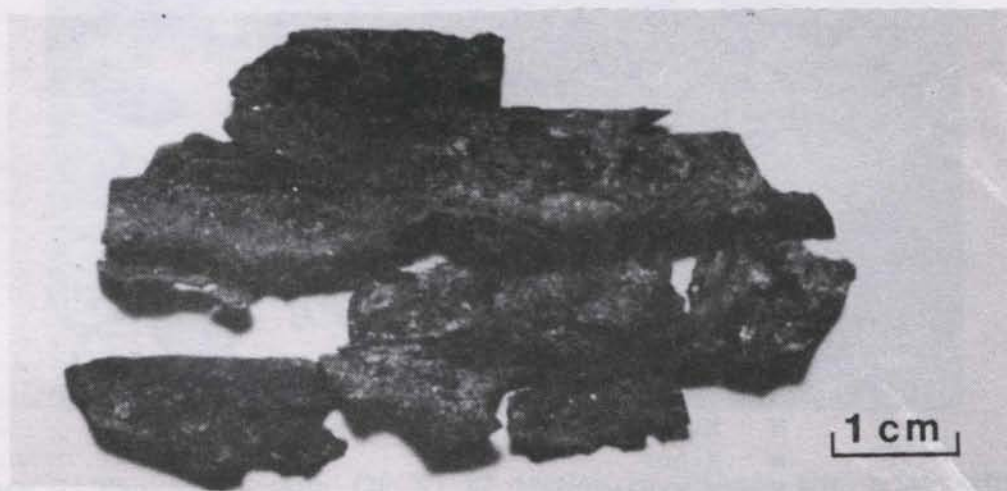


Figure 1. Brass artifact from the Palmer Site (photo courtesy of R. Moir).

One problem in interpreting copper artifacts is that it is not possible to distinguish between native copper and smelted European copper or its related alloys on the basis of visual characteristics alone. The difference is an important one, especially in terms of identifying sites that date from the Contact period. In order to discern whether the Palmer site piece was of native or European origin, small fragments were subjected to two different forms of analysis.

The first was a qualitative chemical analysis done by means of optical emission spectrography (Tite 1972:260-264). While this technique shows which elements are present in the sample, it only provides a visual estimate of their relative proportions. Analysis of the Palmer site piece indicated that the predominant components are copper, zinc, and tin (see Table 1). The common name for this copper alloy is brass. Since there is no evidence to date that native people in North America cast or alloyed copper, the chemical analysis strongly suggests that the metal was imported from Europe (Schroeder and Ruhl 1972; Vernon 1986). Furthermore, the composition of the Palmer site piece is very similar to that of other sixteenth and early seventeenth century brasses recovered elsewhere in the Northeast (Bullen 1949:128-129; Bradley 1987b:217-218).

Identification of the Palmer site metal as European in origin was confirmed by the second analytic technique used, metallographic examination of the specimen's internal structure. A small piece of metal was mounted, polished, and etched with potassium

TABLE 1

Results of optical emission spectrography.

<u>Element</u>	<u>Relative amount present</u>
Cu	M
Zn	m++
Pb	m++
Sn	m+
Ag	m
Fe	m
Mg	m
Mn	m
Si	m
Ni	V+
Al	V
Bi	?

KEY:

- M - Major
- m - Minor
- V - Visible
- ? - Questionable

dichromate according to standard metallographic techniques (Kehl 1949; Tite 1972). Examination of the prepared section under a microscope revealed the presence of small oxide inclusions (the dark dots in Figure 2), indication that the metal was originally smelted and cast.

Metallographical analysis also provides a means for reconstructing the processes to which the metal was subjected after casting. Despite the extensive corrosion and cracking which had occurred along the grain boundaries (the thick, dark lines in Figure 2, Arrow B, for example) as a result of prolonged burial in the ground, the final stages of the manufacturing process remained clearly evident. The large grain size and presence of annealing twins (the thin, paired bands in Figure 2, Arrow C, for example) indicate that the metal was worked and then annealed (reheated) in order to make it malleable again. Slip banding (sets of very thin dark stripes shown in Figure 3, Arrow D) and the slightly bent nature of an annealing twin boundary (Figure 3, Arrow E) reveal that the metal received some additional cold working subsequent to annealing.

This evidence of annealing and cold working can be interpreted in two ways. First, it is likely that these reflect the final stages of European processing. Virtually all the sheet copper (and related alloys) found on 16th and early 17th century sites in the Northeast came to the New World in kettle form. Although the size could vary considerably, these kettles were made in a highly standardized manner. The body was initially formed by the battery method, that is, hammered out from a piece of cast slab, and then finished on a lathe (Bradley 1987b:197). Since both hammering and lathe turning hardened the brass, it was necessary to anneal the work during production so that the metal remained malleable enough for final finishing. It was in this last stage of finishing that some cold working by hammering or bending would have occurred.

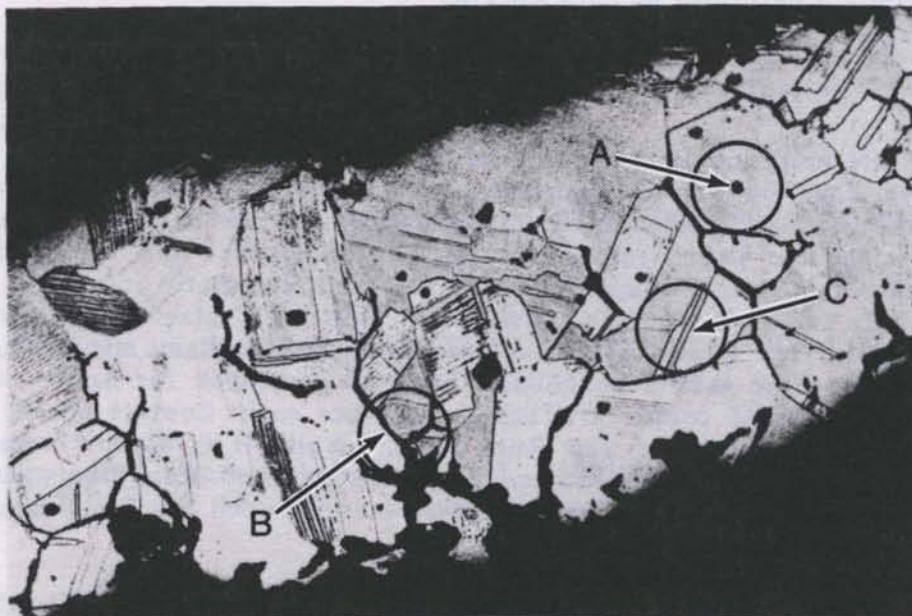


Figure 2. Photomicrograph (200X) of section of Palmer site brass artifact, potassium dichromate etch. Arrow A points to an oxide inclusion; Arrow B to an example of cracking along grain boundaries; Arrow C to annealing twins.



Figure 3. Photomicrograph (500X) of lower mid-portion of section shown in Fig. 2. Arrow D points to slip bands and Arrow E to a portion of annealing twin boundary deformed by cold working.

A second interpretation is that the annealing and cold working evident in the Palmer site piece were done by native Americans. The technology for shaping and hardening copper by hammering and softening it through annealing are known to have been used in the Northeast since the Late Archaic (Bastian 1961; Schroeder and Ruhl 1968). Moreover, there is evidence that native copper was actively used, especially in coastal New England, during the Middle and Late Woodland periods and into the Contact period (Bradley 1987a:41; Childs 1987). It is very likely that once European copper became available, native people manipulated it using the same technologies they had developed for native copper. Indeed, metallographic analysis of copper artifacts from other early Contact period sites indicates that this was the case (Dunbar and Ruhl 1974). While it is almost certain that native craftsmen had cut, folded, and otherwise worked the piece of brass from the Palmer site, it is not clear from the available evidence whether that included the final annealing and cold working.

Chemical and metallographic analyses are powerful techniques for identifying the composition of metal artifacts and reconstructing how they were made and modified. Many more studies of this kind will help resolve interpretive dilemmas concerning processes of metal modification and technological adaptations to new materials and techniques. In the meantime, continued use of these methods provide the important opportunity to identify additional Contact period sites, such as the Palmer site.

Acknowledgement. The authors would like to thank Randy Moir for making his notes and photographs of the Westfield site salvage available, and Heather Lechtman, Center for Materials Research in Archaeology and Ethnology, MIT, for providing us access to the laboratory facilities.

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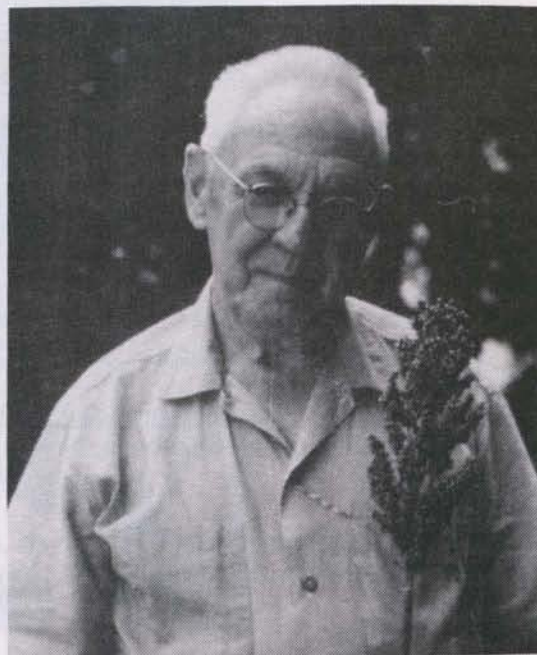
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IN MEMORIAM: ROY C. ATHEARN, 1895-1986.

by Ruth Carol Barnes

As co-director of excavations at Bear Swamp 1 and 2 and Peace Haven, excavator at Wapanucket and other Cohannet Chapter sites, volunteer at the Bronson Museum, member of the Cohannet Chapter, MAS, and collector, Roy Athearn devoted much of his life to archaeology. Together with his wife Eleanor and son Thomas, he helped other members of Cohannet Chapter to create a warm, friendly atmosphere that encouraged learning and participation by all. A skilled tool and die maker by profession, Roy acquired a wide background in natural history and an intimate knowledge of the local landscape, which he applied to investigations of the past. Archaeological materials were for him living, tangible links with their makers. He combined meticulous analysis of individual features and artifacts with knowledge of the environment to create insights that brought the past to life for himself and for those who dug with him. Quiet and unassuming, he willingly placed his data and knowledge at the service of others. Those who worked with Roy will always be grateful for his kindness, enthusiasm, and gentle humor.



Roy Athearn, holding sorghum at Wapanucket in 1972 (J. J. Rivard collection, Bronson Museum).

From the beginning, Roy realized that documentation is the key to interpretation in archaeology. Not only did he co-author the publications listed below, but the records of his extensive collection put to shame the catalogs of many museums. His collection was for him not a personal possession or achievement, but a trust given through him from the past to the future. It stands as a memorial to his hard work and dedication. The Roy Athearn Collection will be displayed at the Somerset Historical Society Museum in Somerset, Massachusetts.

Publications of Roy Athearn:

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1969 The Bear Swamp Site: A Preliminary Report. Bulletin of the Massachusetts Archaeological Society 30(3-4):1-9.

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IN MEMORIAM: ROLAND WELLS ROBBINS, 1908-1987.

by Elizabeth A. Little

Roland Wells Robbins of Lincoln, who joined the Massachusetts Archaeological Society in 1949, was an enthusiast for independent research, the exploration of historical landmarks, and the study of land use by colonial New Englanders, all of which formed the basis of his career as a teacher and lecturer (Robbins 1938, 1945).

I well remember about 1972 trying to keep pace with him in the woods of Lincoln, as he guided the Lincoln Historical Society around the remains of the canals and dams of an old grist mill site. At that time he was arguing the importance of the site, which lay in the path of a proposed highway relocation, and the urgent need for the Society to be involved in its preservation and interpretation. That was the beginning of my own interest and commitment to local archaeology and history.

Mr. Robbins rediscovered and focussed public interest in a number of America's earliest historic sites such as: Henry Thoreau's house site at Walden Pond (Robbins 1947), John Alden's first home in Duxbury (Robbins 1969), the Rev. Samuel Parris parsonage in Salem, the Saugus Ironworks, now a National Historic site, and the Oliver Mills in Middleborough. He also worked at the colonial fortifications at Crown Point, Philipsburg Manor, and Sterling Blast Furnace in New York, Thomas Jefferson's birthplace in Virginia, and many other sites along the east coast (Robbins 1959).

A well known resident of Lincoln, Mr. Robbins had built in his backyard a replica of Thoreau's Walden house, where a register of visitors from all over the world testifies to the extent of his reach.

Publications of Roland W. Robbins:

- 1938 Thru the Covered Bridge. Barnstead, Stoneham, reprinted in 1986 by Academy Books, Rutland, Vermont.
- 1945 The Story of the Minute Man. Barnstead, Stoneham.
- 1947 Discovery at Walden. Barnstead, Stoneham.
- 1959 (with E. Jones) Hidden America. Knopf, New York.
- 1969 (with E. Jones) Pilgrim John Alden's Progress: Archaeological Excavations in Duxbury. The Pilgrim Society, Plymouth.

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INDEX TO VOLUMES 39 THROUGH 48, 1978-1987

The inclusive 38 year index in the 1978 Bulletin of the Massachusetts Archaeological Society (volume 38, number 4), and the Chicago Manual of Style (13th edition, 1982), have provided a model and guidance for this 10 year index of the Bulletin. It consists of three parts. An author index lists each author alphabetically by last name, the date and title of the article, its volume number, and inclusive page references. The title index lists alphabetically all titles, omitting initial articles, "The", "A", "An". The title is followed by the author's name, the volume and page number. The subject index lists subjects, followed by the volume and page number of the articles which treat the corresponding subjects. The subject index, although extensive, is not comprehensive. Note that since 1978, the Bulletin has consisted annually of one volume in two numbers, with continuous pagination within each volume. Therefore, it is no longer necessary to index the issue number.

AUTHOR INDEX

A

- Andrews, J. Clinton, 1986, Indian Fish and Fishing off Coastal Massachusetts, 47:42-46. *See also* Little and Andrews, 1986
Athearn, Roy, Carol Barnes, and Arthur C. Staples, 1981, A Middle/Late Woodland Shell Midden at Peace Haven 2, 42:11-15

B

- Barber, Russell J., 1981, True Blades in Massachusetts, 42:25-27; 1984, Treasures in the Peabody's Basement: A Button Mold with an Extraordinary Incised Figure, 45:49-51; 1986, Correction, 47:80
Barnes, Ruth Carol, 1987, In Memoriam: Roy C. Athearn, 1895-1986, 48:48. *See also* Athearn, Barnes and Staples, 1981
Bates, Ralph S., 1986, In Memoriam: Henry Hornblower II (1917-1985), 47:81
Borstel, Christopher L. and Linda A. Towle, compilers, 1986, Current Directions in the Archaeology of Cape Cod and the Islands, 47:1-38
Borstel, Christopher L., 1986, Current Directions: An Introduction. In Current Directions in the Archaeology of Cape Cod and the Islands, 47:1-5
Bowman, William F., 1981, Sally Rock Quarry, 42:39-40
Bradley, James W., and S. Terry Childs, 1987, Analysis of a Copper Artifact from the Palmer Site, Westfield, Massachusetts, 48:55-59
Bradley, James W., Francis P. McManamon, Thomas F. Mahlstedt, and Ann L. Magennis, 1982, The Indian Neck Ossuary: A Preliminary Report, 43:47-59
Brady, Philip, 1984, A Possible Bone Effigy Face, 45:23-24; 1986, In Memoriam: Mabel Bruce Robbins (1902-1985), 47:38; 1986, Possible Christian Indian Headstone, 47:78-80; 1987, Artifact, Purpose Unknown. Natick, Mass., 48:22-23
Brenner, Elise M., 1986, Archaeological Investigations at a Massachusetts Praying Indian Town, 47:69-78
Bulkley, Morgan. *See* Parrish et al., 1983
Burt, Richard L. *See* Petersen and Burt, 1985

C

- Cammissa, Alfred, 1984, A Comparison of Settlement Patterns and General Land Use Between the Native Americans and the English Settlers in Southern New England in the Seventeenth Century, 45:66-77
- Carlson, Robert. *See* Petersen et al., 1987
- Carty, Frederick M., 1983, Report of a Cache of Points Relating to the Susquehanna Tradition, 44:6-16
- Chase, Mary F. *See* Eteson, Crary and Chase, 1978
- Childs, S. Terry. *See* Bradley and Childs, 1987
- Crary, Marilyn D. *See* Eteson, Crary and Chase, 1978

D

- DeNatale, Douglas, 1980, Petrography, X-Ray Diffractometer Analysis and Quarry Sites. In *The Green Hill Papers: Part One*, 41:11-14
- DePaoli, Neill, 1984, Pemmaquid, Maine: Preliminary Reconstruction of a Seventeenth Century Coastal Community's Domestic and International Trade Connections, 45:24-41
- Dimmick, David H., 1987, Impressions of a Husband, Montgomery, Alabama, 48:34-35
- Dincauze, Dena F., 1980, Editor's Note. In *The Green Hill Papers: Part Two*, 41:29; editor, 1978, Index to Volumes 1-38, 38(4):1-32
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E

- Eteson, Marie O., 1982, The Hayward's Portanimicutt Site (19-BN-324), 43:6-30; 1985, Thermoluminescent Dating Analysis of a Cape Cod Potsherd, 46:61-62
- Eteson, Marie O., Marilyn D. Crary, and Mary F. Chase, 1978, The Mattaquason Purchase Site (M48N6), North Chatham, 39:1-38.

F

- Fowler, William S., 1982, A Discussion of Two Burials from Taylor Farm, 43:46-47

G

- Gero, Joan M., and Dolores Root, 1979, The Collector's Contribution to Archaeological Surveys in New England, 40:20-22
- Gramley, Richard Michael, and Gretchen Gwynne, 1979, Two Late Woodland Sites on Long Island Sound, 40:5-19
- Gwynne, Gretchen. *See* Gramley and Gwynne, 1979

H

- Hartwell, John J., 1983, In Memoriam: William Biggar Brierly (1912-1983), 44:29-30
- Haynes, Henry W., 1985, Localities of Quarries Worked by the Indians for Material for their Stone Implements, 46:42-43
- Hoffman, Curtiss, 1983, A Dated Feature Complex from Charlestown Meadows and its Implications for Regional Prehistory, 44:43-54; 1984, A Second Sixth-Millennium Radio-Carbon Date from Charlestown Meadows, 45:77-81; 1987, Culture's Pitfalls: The Evidence for Prehistoric Backfilling, 48:24-34
- Horner, George R., 1979, The Excavation of the Glass Furnace in Quincy, Massachusetts, 40:27-39

J

- Jackson, Alan. *See* Mackie et al., 1983
- Johnson, Eric S., and Thomas F. Mahlstedt, 1984a, The Roy Athearn Collection: A Report from the Massachusetts Historical Commission's Statewide Survey, 45:3-9; 1984b, Report on the Benjamin Smith Archaeological Collection, Concord, MA, 45:51-65; 1985, The Charles Read Archaeological Collection, Seekonk, Massachusetts, 46:56-61
- Johnson, Mary K., 1983, An Archaeologist's Guide to Deed and Literature Research, 44:55-61
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K

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- Kerber, Jordan E., 1985, Potowomut Cores and Quahogs: Archaeology and the Environmental and Biological Sciences, 46:62-65

L

- Largy, Tonya, 1985, An Unusual Notched Pendant, 46:51-55; 1987. *See also* Petersen, Largy and Carlson, 1987
- Larson, Clark Spencer. *See* Mackie et al., 1983
- Laugelli, Josephine, 1979, In Memoriam: Guy Mellgren, 40:1
- Lawn, Alexander G., *See* Jorgensen and Lawn, 1983
- Little, Elizabeth A., 1981, The Mattequecham Wigwam Murder, 42:15-23; 1984, Locus Q-6, Site M52/65, Quidnet, Nantucket, Massachusetts, 45:9-23; 1986, Observations on Methods of Collection, Use, and Seasonality of Shellfish on the Coast of Massachusetts, 47:46-59; 1987, Editor's Note, 48:1; 1987, In Memoriam: Roland Wells Robbins: 1908-1987, 48:54.
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M

- Mackie, Norman Vardney III, Clark Spencer Larson, Mary Shotwell, and Alan Jackson, 1983, The Cedar Dell Pond Site: 19BR218, 44:31-39
- MacNeish, Richard S., 1979, In Memoriam: Douglas Swain Byers, 40:2-4
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- McGahan, Jane A., 1983, The Blaine Site: 19-FP-49, 44:21-28
- McManamon, Francis P. *See* Bradley et al., 1982
- Moody, William E., 1987, Saving a Late Archaic Workshop from the Backhoe, 48:49-53
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Newport, Rhode Island, 45:41-47

P

- Painter, Floyd, 1985, A Commentary on the "Late Archaic" Classification of the Satucket Cache, 46:35-39
- Parrish, James N., Thomas Marino, and Morgan Bulkley, 1983, Recent Paleontological Discovery in Berkshire County, 44:20-21
- Petersen, James B., and Richard L. Burt, 1985, An Aboriginal Ceramic Vessel from Chilmark, Dukes County, Massachusetts, 46:1-10
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R

- Rapoza, Andrew. *See* Rosser et al., 1980
- Robbins, Maurice, 1984, In Memoriam: William Smith Fowler (1893-1983), 45:1-2
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- Russell, Howard, 1978, Letters to the Editor, 39:39

S

- Shea, John J., 1985, Experiments in Debitage Analysis: Some Testable Hypotheses, 46:44-50
- Shotwell, Mary. *See* Mackie et al., 1983
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T

- Talmage, Valerie A., 1982, Massachusetts General Laws and Human Burials, 43:60-65
 Taylor, William B., 1980, (Photograph) Artifacts from the William B. Taylor Collection, 41:59-60; 1981, Matching Can Be Fun, 42:37-38; 1982, The Taylor Farm Site, 43:40-46
 Thomas, Peter A., 1979, The Upper Housatonic Valley: Archaeological Inference and the Need for Basic Research, 40:22-26; 1979, The Wills Hill Site: A Middle Woodland Hunting-Gathering Camp, 40:39-54
 Towle, Linda A., 1986, Investigating the Fox Creek Phase on Cape Cod. In Current Directions in the Archaeology of Cape Cod and the Islands, 47:28-34. *See also* Borstel and Towle, 1986
 Trinkaus, Erik, 1982, The Human Skeleton from the Nantucket Field Station Site, 43:37-39
 Turchon, Frederic H., 1982, A Woodland Burial from Nantucket, 43:34-37

W

- Weinstein, Laurie Lee, 1985, The Dynamics of Seventeenth Century Wampanoag Land Relations: The Ethnohistorical Evidence for Locational Change, 46:19-35; 1986, Seventeenth Century Southern New England Indian Agriculture, 47:59-68

Z

- Zannier, Paula. *See* Rosser et al., 1980
 Zeoli, Gerald D., 1978, Two Grooved Axe Associations from the South Shore, 39:41-46

TITLE INDEX

A

- Aboriginal Basketry Fragment from Lake Cochituate, Natick, Massachusetts, An, James B. Petersen, Tonya Largy, and Robert Carlson, 48:2-8
 Aboriginal Ceramic Vessel from Chilmark, Dukes County, Massachusetts, An, James B. Petersen and Richard L. Burt, 46:1-10
 Analysis of a Copper Artifact from the Palmer Site, Westfield, Massachusetts, James W. Bradley and S. Terry Childs, 48:55-59
 Archaeological Investigations at a Massachusetts Praying Indian Town, Elise M. Brenner, 47:69-78
 Archaeologist's Guide to Deed and Literature Research, An, Mary K. Johnson, 44:55-61
 Artifact, Purpose Unknown. Natick, Mass., Philip Brady, 48:22-23
 Artifact Stratigraphy at the Base of Green Hill, John Rosser, Andrew Rapoza, and Paula Zannier, 41:41-45
 Artifacts from the William B. Taylor Collection (Photograph), 41:59-60
 Avocational Archaeologists and Contract Archaeology, Barbara E. Luedtke, 40:54-55

B

- Back Porch Site: M39-SE50, The, Arthur C. Staples, 44:16-20
 Blaine Site: 19-FP-49, The, Jane A. McGahan, 44:21-28

C

- Cedar Dell Pond Site: 19BR218, The, Norman Vardney Mackie III, Clark Spencer Larson,

- Mary Shotwell, and Alan Jackson, 44:31-39
Charles Read Archaeological Collection, Seekonk, Massachusetts, The, Eric S. Johnson and Thomas F. Mahlstedt, 46:56-61
Collector's Contribution to Archaeological Surveys in New England, The, Joan M. Gero and Dolores Root, 40:20-22
Commentary on the "Late Archaic" Classification of the Satucket Cache, A, Floyd Painter, 46:35-39
Comparison of Prehistoric Ceramics from Shell Midden and Non-Shell Midden Sites on Cape Cod and Martha's Vineyard, A, George H. Stillson, 47:12-18
Comparison of Settlement Patterns and General Land Use Between the Native Americans and the English Settlers in Southern New England in the Seventeenth Century, A, Alfred Cammisa, 45:66-77
Correction, Russell J. Barber, 47:80
Culture's Pitfalls: The Evidence for Prehistoric Backfilling, Curtiss Hoffman, 48:24-34
Current Directions in the Archaeology of Cape Cod and the Islands, compiled by Christopher L. Borstel and Linda A. Towle, 47:1-38
Current Directions: An Introduction, In Current Directions in the Archaeology of Cape Cod and the Islands, Christopher L. Borstel, 47:1-5

D

- Dated Feature Complex from Charlestown Meadows and its Implications for Regional Pre-History, A, Curtiss Hoffman, 44:43-54
Development of the Narragansett Confederacy: An Economic Perspective, The, Harvey C. Jorgensen and Alexander G. Lawn, 44:1-6
Discussion of Two Burials from Taylor Farm, A, William A. Fowler, 43:46-47
Dynamics of Seventeenth Century Wampanoag Land Relations, The: The Ethnohistorical Evidence for Locational Change, Laurie Lee Weinstein, 46:19-35

E

- Editorial Greeting, Barbara E. Luedtke, 42:1-2
Editor's Note, Dena F. Dincauze, 41:29; Barbara E. Luedtke, 42:25; 43:1,33-34; 44:1,62; 45:1,49; 46:1,41-42; 47:1,41-42; Elizabeth A. Little, 48:1
Effigy Pipe Bowl from Baptist Hill, Palmer, An, John Pretola, 47:68-69
End Picks from the North Wilbraham Steatite Quarry, Some, John Pretola, 44:39-43
Excavation of the Glass Furnace in Quincy, Massachusetts, The, George R. Horner, 40:27-39
Experiments in Debitage Analysis: Some Testable Hypotheses. John J. Shea, 46:44-50

F

- Features at the Base of Green Hill, John Rosser, 41:29-41
Filling in the Gaps (And Adding New Ones): Collections Analysis on Cape Cod and the Islands, Thomas Mahlstedt, 47:5-12

G

- Geological Setting of the Green Hill Site, The, David C. Roy, 41:5-11
Granfield Site, The, John Pretola, 48:9-21
Green Hill Papers, The: Part One and Part Two, compiled by John Rosser, 41:1-57

H

- Hayward's Portanimicutt Site (19-BN-324), The, Marie O. Eteson, 43:6-30
Human Skeleton from the Nantucket Field Station Site, The, Eric Trinkaus, 43:37-39

I

- Impressions of a Husband, Montgomery, Alabama, David H. Dimmick, 48:34-35
 Index to Volumes 39 through 48, 1978-1987, 48:60-71
 Indian Fish and Fishing off Coastal Massachusetts, J. Clinton Andrews, 47:42-46
 Indian Neck Ossuary, The: A Preliminary Report, James W. Bradley, Francis P. McManamon, Thomas F. Mählstedt, and Ann Magennis, 43:47-59
 In Memoriam: Roy C. Athearn: 1895-1986, Ruth Carol Barnes, 48:48
 In Memoriam: William Biggar Brierly (1912-1983), John J. Hartwell, 44:29-30
 In Memoriam: Douglas Swain Byers, Richard S. MacNeish, 40:2-4
 In Memoriam: William Smith Fowler (1893-1983), Maurice Robbins, 45:1-2
 In Memoriam: Henry Hornblower II (1917-1985), Ralph S. Bates, 47:81
 In Memoriam: Guy Mellgren, Josephine Laugelli, 40:1
 In Memoriam: Mabel Bruce Robbins (1902-1985), Philip Brady, 47:38
 In Memoriam: Roland Wells Robbins: 1908-1987, Elizabeth A. Little, 48:54
 In Memoriam: Benjamin Lincoln Smith (1900-1981), Stephen Loring, 43:2-6
 Introduction, John Rosser, In The Green Hill Papers: Part One, 41:1-5
 Investigating the Fox Creek Phase on Cape Cod, Linda A. Towle, 47:28-34

L

- Letters to the Editor, Howard Russell; William G. Stead, 39:39
 Localities of Quarries Worked by the Indians for Material for their Stone Implements, Henry W. Haynes, 46:42-43
 Locus Q-6, Site M52/65, Quidnet, Nantucket, Massachusetts, Elizabeth A. Little, 45:9-23

M

- Massachusetts General Laws and Human Burials, Valerie A. Talmage, 43:60-65
 Matching Can Be Fun, William B. Taylor, 42:37-38
 Mattaquason Purchase Site (M48N6), North Chatham, Marie O. Eteson, Marilyn D. Crary, and Mary F. Chase, 39:1-38
 Mattequecham Wigwam Murder, The, Elizabeth A. Little, 42:15-23
 Middle/Late Woodland Shell Midden at Peace Haven 2, Roy Athearn, Carol Barnes, and Arthur C. Staples, 42:11-15
 Miniature Steatite Pot, A, John Alfred Mansfield, 46:55-56

N

- Nature's Transformations and Other Pitfalls: Toward a Better Understanding of Post-Occupational Changes in Archaeological Site Morphology in the Northeast. Part I: Vegetation, Alan E. Strauss, 39:47-64
 Nature's Transformations and Other Pitfalls: Toward a Better Understanding of Post-Occupational Changes in Archaeological Site Morphology in the Northeast. Part II: Invertebrates, Alan E. Strauss, 42:2-11
 Nature's Transformation and Other Pitfalls: Toward a Better Understanding of Post-Occupational Changes in Archaeological Site Morphology in the Northeast. Part III: Animal Activity and Frost Action, Alan E. Strauss, 46:65-72
 New England's Urban Prehistory: Evidence from Two Sites in Newport, Rhode Island, Stephen A. Mrozowski, 45:41-47
 19BN468, Chatham, Massachusetts: Site Salvage with a Research Orientation, Frederick J. Dunford, 47:34-38

O

- Observations on Methods of Collection, Use, and Seasonality of Shellfish on the Coast of Massachusetts, Elizabeth A. Little, 47:46-59

P

- Paleoethnobotany of Green Hill, The, Lawrence Kaplan, 41:15-19
Pemmaquid, Maine: Preliminary Reconstruction of a Seventeenth Century Coastal Community's Domestic and International Trade Connections, Neill DePaoli, 45:24-41
Pennsylvania Connection, The: Jasper at Massachusetts Sites, Barbara E. Luedtke, 48:37-47
Petrography, X-Ray Diffractometer Analysis and Quarry Sites, Douglas DeNatale, 41:11-14
Possible Bone Effigy Face, A, Philip Brady, 45:23-24
Possible Christian Indian Headstone, Philip Brady, 47:78-80
Potowomut Cores and Quahogs: Archaeology and the Environmental and Biological Sciences, Jordan E. Kerber, 46:62-65
Prehistoric Shellfish Harvesting at Nantucket Island, Elizabeth A. Little and J. Clinton Andrews, 47:18-27
Preliminary Functional Analysis of Stone Tools, A, Michael E. Roberts, 41:46-53
Preliminary Prehistory of Agawam, A: Analysis of the Charles W. Hull Collection, John Pretola, 46:10-19

R

- Recent Paleontological Discovery in Berkshire County, James N. Parrish, Thomas Marino, and Morgan Bulkley, 44:20-21
Recent Wild Fauna, Robert Stanhope, 41:20-21
Report of a Cache of Points Relating to the Susquehanna Tradition, Frederick M. Carty, 44:6-16
Report on the Benjamin Smith Archaeological Collection, Concord, MA, Eric S. Johnson and Thomas F. Mahlstedt, 45:51-65
Report on the Bronson Museum, Massachusetts Historical Commission, 42:30-36
Roy Athearn Collection, The: A Report from the Massachusetts Historical Commission's Statewide Survey, Eric S. Johnson and Thomas F. Mahlstedt, 45:3-9

S

- Sally Rock Quarry, William F. Bowman, 42:39-40
Salvage Archaeology at Indian Rock House, Bernard W. Powell, 42:40-49
Saving a Late Archaic Workshop from the Backhoe, William E. Moody, 48:49-53
Second Sixth-Millennium Radio-Carbon Date from Charlestown Meadows, A, Curtiss Hoffman, 45:77-81
Segreganset River Site: M39-SE102, The, Arthur C. Staples, 42:27-29
Seventeenth Century Southern New England Indian Agriculture, Laurie Lee Weinstein, 47:59-68
Summary and Interpretations, John Rosser, in The Green Hill Papers: Part Two, 41:53-57

T

- Taylor Farm Site, The, William B. Taylor, 43:40-46
Thermoluminescent Dating Analysis of a Cape Cod Potsherd, Marie O. Eteson, 46:61-62
Treasures in the Peabody's Basement: A Button Mold with an Extraordinary Incised Figure, Russell J. Barber, 45:49-51
True Blades in Massachusetts, Russell J. Barber, 42:25-27
Two Grooved Axe Associations from the South Shore, Gerald D. Zeoli, 39:41-46

Two Late Woodland Sites on Long Island Sound, Richard Michael Gramley and Gretchen Gwynne, 40:5-19

U

Unusual Notched Pendant, An, Tanya Largy, 46:51-55

Upper Housatonic Valley, The: Archaeological Inference and the Need for Basic Research, Peter A. Thomas, 40:22-26

W

Wills Hill Site, The: A Middle Woodland Hunting-Gathering Camp, Peter A. Thomas, 40:39-54
Woodland Burial from Nantucket, A, Frederic H. Turchon, 43:34-37

SUBJECT INDEX

A

Agriculture, Indian: 17th century, 45:66, 47:59

Analysis. *See* artifacts, ceramics, collections, lithics

Archaeology: avocational, 40:54, 42:1, 43:1, 44:1, 45:1,49; contract, 40:20,22,39,54

Archaic period sites: Early, 44:31, 48:9; Middle, 39:41, 41:41, 44:31,43, 48:9; Late, 41:41, 42:27,40, 44:16,21,31, 43; 45:41,77; 48:9,49

Artifacts: analysis, 43:6, 44:6, 46:35; classification. *See also* taxonomy; collections, colonial artifacts, copper, stone, bone and antler artifacts, ceramics, glass, fibers, pipes, beads

B

Beads: bone, 43:6; glass, 45:24

Bone and antler artifacts: effigies, 45:23; tools, 39:1, 40:5, 43:6

Botanical resources: modern, 39:1, 41:15, 44:31; historic, 47:59; prehistoric, 40:5,22, 41:15, 45:77, 48:9

Bowls, stone. *See* steatite

Bronson Museum. *See* collections

Burials, 43:33,34,37,40,46; cremations, 43:47; grave goods, 47:69, 48:55; possible headstone, 47:78; Massachusetts laws, 43:60; ossuary, 43:47; physical analysis, 43:37,47

C

Caches, 44:6; 46:35

Cape Cod and the islands, archaeology of, 39:1, 43:6,32,34,37,47, 45:9, 46:1, 47:1,5,12,18,28,34,42; ethno-history of, 42:15

Ceramics: analysis, 39:1, 43:6, 47:12; Woodland, 42:40, 41:53, 44:16,21, 47:12; Middle Woodland, 43:6; Middle/Late Woodland, 39:1; 42:11, 43:6; Shantok, 43:46; Late Woodland, 40:5, 46:1. *See also* colonial artifacts

Chapters: Cape Cod, 39:1, 43:6, 47:12; Eckblaw, 44:43, 45:77; Norwottuck, 44:21

Chronology, cultural, 41:53, 44:43

Coins, Spanish, 42:40

Collecting, amateur, 40:20

Collections, inventory and analysis of, 40:22, 45:24; Bronson Museum, 42:30; Roy Athearn, 45:3; Cape Cod and the Islands, 47:5,28; Charles W. Hull, 46:10; Charles Read, 46:56; Benjamin Smith, 45:51

Colonial artifacts, ceramics, 39:1, 40:27, 45:24; flint, 39:1; glass, 39:1, 40:27; iron, 39:1, 40:27, 45:24; lead, pewter, 42:40, 45:24; silver, 42:40

Colonial Period: glass furnace, 40:27; Praying Indian town, 47:69; settlement patterns, 42:15, 45:66, 46:19; sites, 42:40, 45:24,41. *See also* colonial artifacts, ethno-history

Connecticut, artifact, 47:78; site, 42:40

Contact Period, 44:1; 48:55

Copper, 41:41; 48:55

Copyright, 44:62

Corn, 47:59

Cremations. *See* Burials

Culture change. *See* Colonial Period, Contact Period

D

Dates: by association, 39:41; by radio-carbon, 40:5, 44:31,43, 45:9,77, 46:62, 47:12,18, 48:9; by thermoluminescence, 46:61

Dogs, Indian, 39:1, 40:5

E

Editorials: Dincauze, 41:29; Luedtke, 42:1,25; 43:1,33; 44:1,62; 45:1,49; 46:1,41; 47:1,41; Little, 48:1

Effigies, 45:23, 45:24

Environmental changes: Massachusetts interior, 40:22, 44:20; Massachusetts coastal, 47:18; Rhode Island coastal, 46:62

Ethnohistory, 44:1, 45:66, 46:19, 47:59; burial pot, 43:46; murder trial, 42:15; Praying Indians, 47:69; shellfishing, 47:18,46

Excavation, purposes of, 47:34

F

Faunal resources, prehistoric: birds, 40:5, 43:6; mammals, 39:1, 40:5,39,

43:6; fish, 39:1, 40:5, 43:6, 47:42; shellfish, 39:1, 40:5, 47:18,46; turtles, 39:1, 40:5,39, 43:6

Faunal resources, historic/modern, 41:20, 44:31

Features: analysis, 48:24; clay lenses, 39:1, 42:40; hearths 40:5, 41:29, 42:27, 44:21; post molds, 40:5, 41:29; red earth pits, 45:77; soil stains, 41:29, 44:31; stone pavement, 44:43; stone-lined hearths, 44:31; stone piles, 41:29; storage/refuse pits, 39:1, 40:5, 41:29, 42:11, 44:43, 45:9. *See also* burials

Fibers, baskets, 48:2

Fishing, 47:42

Functional analysis. *See* lithic analysis, use-wear

G

Geological setting, 41:5

Glass: beads, 45:24

Graphite or coal, 41:41, 44:16

Green Hill site, 41:1

H

Harpoons, Indian, 43:6

Historic period sites. *See* colonial period

History, southern New England, 45:24,66

I

Incised stones, 45:49, 46:51, 47:80

Indices: Vol. 1-Vol. 38, 38(4):1-34; authors, 38(4):2; subjects,38(4):25; titles, 38(4):12; institutional subscribers, 38(4):31

Interpretive techniques, 39:41, 40:22, 47:69

J

Jasper, 39:1, 40:5, 42:11,25,27, 44:43, 45:77, 46:42, 48:2,37

L

Letters to the Editor: biographies of authors, 39(1):39; measures, 39(1):39

Lithic analysis: flaking technology, 46:44; petrography, 41:11; restoration, 42:37; use-wear analysis 41:46; X-Ray diffractometer, 41:11; NMR study, 48:37. *See also* taxonomy

M

Maine, Pemmaquid, history and archaeology, 17th century, 45:24

Maize. *See* corn

Mastodon, 44:20

Measures, system of. *See* letters to the editor

Multicomponent sites, 39:1, 44:21,31

Multidisciplinary research, 46:62, 47:69

N

New York State: Long Island sites, 40:5

O

Obituaries: Roy C. Athearn, 48:48; William Biggar Brierly, 44:29; Douglas Swain Byers, 40:2; William Smith Fowler, 45:1; Henry Hornblower II, 47:81; Guy Mellgren, 40:1; Mabel Bruce Robbins, 47:38; Benjamin Lincoln Smith, 43:2

P

Paleoethnobotany. *See* botanical resources

Paleontology, 44:20

Paleo period, sites, 44:31

Pipes: ceramic, 39:1; kaolin, 39:1, 41:41, 42:40, 45:24; stone effigy, 47:68

Pits. *See* features

Place names: Indian, 46:19

Pollen records, use of, 40:22

Pottery. *See* ceramics

Q

Quarry sites, 41:11, 42:39, 44:6, 46:42, 48:37

R

Radiocarbon. *See* dating

Red ochre (hematite), 41:41, 42:27,40, 44:16,31

Research designs, 47:34

Rhode Island, sites, 45:41, 46:62; ethnohistory, 44:1

Rock: shelters, 42:40, 45:23. *See also* stone, lithic analysis

S

Sea level, changes in, 46:62, 47:18

Seasonality, 39:1, 40:39, 45:9, 46:19,62, 47:46

Settlement patterns, 45:66; coastal, 42:15, 45:41,60, 46:19; interior, upland, 40:22,39

Shells: middens, 39:1, 42:11, 45:9, 46:62, 47:18,34,46; and pottery, 47:12; shellfishing, 47:18,46

Site survey, 40:22, 47:69; *see also* collections; deed and literature research, 44:55; impressions of a novice, 48:34; interviews with collectors, 40:20

Site reports: Cape Cod and the Islands, 39:1, 43:6,34,47, 45:9, 47:28,34; northeastern Massachusetts, 45:23; southeastern Massachusetts, 39:41, 40:27, 41:1; 42:11,27,39, 43:40, 44:6,16,31, 48:2,49; central Massachusetts, 40:39, 44:21,43, 45:77, 48:9; Connecticut, 42:40, 47:78; Rhode Island, 45:41, 46:62; New York, 40:5

Soil analysis. *See* stratigraphy

Steatite: bowl, 46:55

Stone: chipping of, drilling of, flaking of, grinding of, pecking of, identification of, working of. *See* lithic analysis and site reports. Pavement. *See* features. Sources. *See* quarry sites. *See also* stone artifacts

Stone artifacts: adz, 41:41, atlatl weights, 41:41, 44:16; axes, grooved, 39:41, 42:39; bifaces, 41:41; button mold, 45:49, 47:80; celts, 41:41; discoidal stone, 41:59; effigy slate pipe bowl, 47:68; end picks, 44:39; knives, spear points, and projectile points, 41:59, 42:37, 41:41; pendants, 41:41, 46:51; gouges,

41:41; pecked headstone, possibly Christian, 47:78; perforators, 41:41; pestles, 41:41; rubbing stone, 41:41, 42:11; see steatite; ulus, 44:43; unidentified artifact, 48:22

Stratigraphy, disturbances of: by vegetation, 39:47; by invertebrates, 42:2; by animals and frost, 46:65; by people, 48:24

Survey techniques. *See* site survey

T

Taxonomy: projectile points, knives and spears, 39:1, 41:46,53, 42:30, 43:6, 47:5; blades, true, 42:25; end picks, 44:39; pecked and ground stone tools, 43:6. *See also* collections, inventory and analysis of

Trade, 44:1, 45:24, 45:66

W

Woodland sites, 39:1, 43:6, 44:16; Early, 44:21; Middle, 40:39, 44:21,43; 47:12,28; Middle/Late, 42:11,27, 44:31, 48:2; Late, 40:5, 41:1, 44:43; 47:34, 48:9

Workshops, lithic, 40:39, 48:49

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A BRIEF NOTE TO CONTRIBUTORS

The Editor solicits for publication original contributions related to the archaeology of Massachusetts. Manuscripts should be sent to the Editor for evaluation and comment. Authors of articles submitted to the Bulletin of the Massachusetts Archaeological Society are requested to follow the style guide for American Antiquity 48: 429-442 (1983), a copy of which is available at the Bronson Museum. Additional instructions for authors may be found in the Bulletin of the Massachusetts Archaeological Society, Volume 48, Number 1 (1987).

